MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 2, 2019/2020

DCE5038 – ELECTRICAL MEASUREMENT AND INSTRUMENTATION TECHNIQUES

(Diploma in Electronic Engineering)

29 FEBRUARY 2020
2.30 p.m. – 4.30 p.m.
(2 Hours)

INSTRUCTIONS TO STUDENT

1. This question paper consists of 4 pages excluding the cover page and appendix.
2. Answer **ALL** questions.
3. Please write all your answers in the answer booklet provided.

QUESTION 1 [25 MARKS]

a) Define the term measurement system. State the format to write the output of measurement system.

[4 marks]

b) Explain the differences between the following classification of instruments:

i) Monitoring Type and Control type.

[4 marks]

ii) Null and Deflection type.

[4 marks]

c) State whether the following scenarios are either **accurate and precise, precise but not accurate**, or **accurate but not precise.**

i) Wally West did an experiment to measure the total resistance in a circuit. In his first reading, he measured the total resistance as 20.5 Ω. In the second reading he got 23.5 Ω and for his final reading he got 18.5 Ω. The theoretical value for the total resistance for that circuit is 23.5 Ω

[2 marks]

ii) Roy Harper able to shoot at the same spot three times. All of it is 50 m away from the bullseye.

[2 marks]

d) The value specified by the manufacturer for a resistor R is 2 kΩ ± 5%. The actual value of this resistor is 1.9 kΩ.When measured using a multimeter, the resistor gives a value of 1.89 kΩ.Calculate:

i) static error of resistor R.

[3 marks]

ii) relative static error.

[3 marks]

iii) accuracy of the multimeter.

[3 marks]

Continued...

QUESTION 2 [25 MARKS]

a) Define the term controlling force in an indicating instrument. The controlling force then forms the controlling systems. Describe the two functions of the controlling systems.

[6 marks]

b) Explain the operation of the attraction type moving iron instruments.

[6 marks]

c) Draw and label a diagram to show the movement of the moving coil pivot when current is flowing inside the coil in an permanent magnet moving coil (PMMC) instrument.

[3 marks]

d) A PMMC instrument has magnetic flux density of 0.48 T in its air gaps. The diameter and length of the coil are 1.25 cm and 2 cm respectively. With the number of turns, N is 320, find the coil current needed to produce torque of 3.24 μNm.

[4 marks]

e) Sketch and label three diagrams that illustrate the three types of connection for a wattmeter.

[6 marks]

Continued...

QUESTION 3 [25 MARKS]

a) Suggest a method to measure medium resistance.

[2 marks]

b) R_1 *and* R_4, *both* are 10 kΩ resistor. A 1 F capacitor, C_3 and an adjustable resistor that having lowest value of 1 kΩ and maximum value of 5 kΩ, R_3,. There is one a galvanometer with internal resistance, R_G of 300 Ω. There is an unknown resistor R_s, an unknown inductor L_s and a 20 kHz supply frequency.

i) Draw the circuit diagram of a Maxwell Bridge with all the components stated above and label them accordingly.

[8 marks]

ii) The bridge is balanced when $R_3 = 3$ kΩ. Find the value of R_s and L_s.

[6 marks]

iii) Calculate the minimum Q factor.

[3 marks]

c) The Wheatstone bridge shown in the Figure 1 below with $P = 3.0$ kΩ, $Q = 7.0$ kΩ and galvanometer null is obtained when $S = 6.11$ kΩ.

i) Calculate the value of R.

[3 marks]

ii) Determine the minimum value of an unknown resistance R using the above bridge if S is adjustable from 2.00 kΩ to 5.00 kΩ.

[3 marks]

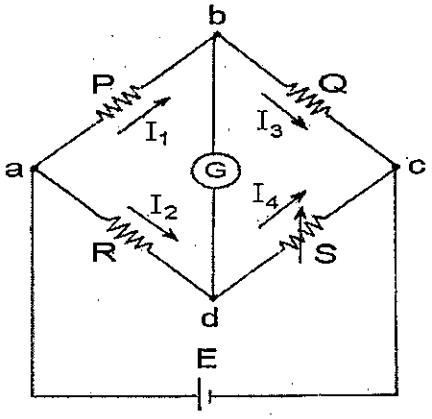

Figure 1

Continued...

QUESTION 4 [25 MARKS]

a) Give two reasons why it is difficult to perform magnetic measurement.

[4 marks]

b) Describe three differences between a ballistic galvanometer and a fluxmeter in terms of the pointer movement, accuracy, sensitivity and the rate of flux change over time.

[8 marks]

c) B-H Curve measurement is an important activity to determine the magnetic properties of a material. State two methods that can help to determine this curve.

[2 marks]

d) State two main elements of a transducer.

[2 marks]

e) A quartz piezo-electric crystal having a thickness of 3 mm and a voltage sensitivity of 0.155 Vm/N is subjected to a stress of 1.2 MN/m^2. Proof the charge sensitivity is 6.1729×10^{-12} C/N and output voltage is 558.0023 V, if the relative permittivity of the quartz is 4.5.

[9 marks]

End of Page.

Appendix

$$X = AB$$

$$\frac{\partial X}{\partial A} = B, \frac{\partial X}{\partial B} = A$$

$$E_L = \frac{Z_L}{Z_L + Z_0} E_0$$

$$I_0 = \frac{E_0}{Z_O}$$

$$I_L = \frac{E_0}{Z_L + Z_0}$$

$$T_D = B\ell IND$$

$$\text{Power loss in current coil} = I^2 R_c$$

$$\text{Power loss in pressure coil} = \frac{V^2}{R_P}$$

$$QR = PS$$

$$V_{TH} = E\left[\frac{R_3}{R_1 + R_3} - \frac{R_4}{R_2 + R_4}\right]$$

$$R_{TH} = \left[\frac{R_1 R_3}{R_1 + R_3} + \frac{R_2 R_4}{R_2 + R_4}\right]$$

$$I_G = \frac{V_{TH}}{R_{TH} + R_G}$$

$$\frac{P}{Q} = \frac{R + \ell_1 R}{S + (L - \ell_1)R}$$

$$Q = 2\pi f C_3 R_3$$

$$Q = \frac{1}{2\pi f C_3 R_3}$$

$$R_S = \frac{R_1 R4}{R_3}$$

$$L_S = C_3 R_1 R_4$$

$$R_P = \frac{R_1 R4}{R_3}$$

$$L_P = C_3 R_1 R_4$$

$$C_1 = C_2 \frac{R_4}{R_3}$$

$$R_1 = \frac{R_3 C_4}{C_2}$$

$$H = \frac{N_P \ell}{\ell}$$

$$B = \frac{K\theta R_S}{2N_S A}$$

$$\mu = \frac{B}{H}$$

$$e_0 = \frac{X_i}{X_t} e_i$$

$$\nu = -\frac{\partial D / D}{\partial L / L}$$

$$G_f = \frac{\Delta R / R}{\Delta L / L} = 1 + 2\nu + \frac{\Delta\rho / \rho}{\varepsilon}$$

$$\varepsilon = \frac{\Delta L}{L}$$

$$\varepsilon_0 = (8.85 \times 10^{-12})$$

$$G_f = 1 + 2\nu$$

$$Q = d \times F$$

$$E = \frac{Q}{C}$$

$$E = \left(\frac{d}{\varepsilon}\right) St = gSt$$

$$g = \frac{d}{\varepsilon}$$

$$E_o = \left(\frac{d}{\varepsilon}\right) St$$

$$C = \frac{\varepsilon A}{d}$$

$$R = R_0\left[1 + \alpha_0(\theta - \theta_0)\right]$$

$$R = R_0 \exp\left[\beta\left(\frac{1}{T} - \frac{1}{T_0}\right)\right]$$

$$V_0 = C_1\left(T_1 - T_2\right) + C_2\left(T_1^{\,2} - T_2^{\,2}\right)$$

End of Page.